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Subject: Shields Camp (FPM Report # NE97-6)

To: Deane Swickard, Bureau of Land Management, Folsom, CA

At the request of Bob Erickson, Yuba Watershed Institute (YWI) and Peggy Cranston, Bureau of Land Management (BLM), I visited the Shields Camp area on May 22, 1997. The objective of the visit was to determine the cause of the ponderosa pine mortality, provide recommendations to limit/reduce future mortality and examine some areas where a prescribed burn was implemented during the fall of 1996. I was accompanied in the field by:

Deane Swickard	Bureau of Land Management
Peggy Cranston	Bureau of Land Management
Ed Bolinger	Bureau of Land Management
Jay Hastings	Bureau of Land Management
Al Franklin	Bureau of Land Management
John Scull	Bureau of Land Management
Bob Erickson	Yuba Watershed Institute
Don Harkin	Yuba Watershed Institute
Ski Skoverski	Yuba Watershed Institute
Darrin Schultz	Yuba Watershed Institute
Ed Yilek	Yilek Milling
Jerry Tecklin	
Robin Petersen	Forest Pest Management

The Shields Camp area is managed by the Bureau of Land Management. The Yuba Watershed Institute is comprised of a group of citizens from the San Juan Ridge area, whose special interest is the maintenance of the long term biological integrity and wise use of natural resources within the Yuba River watershed. Stands in Shields Camp (T17N R9E S3, T18N, R9E S34) are mixed conifer with the majority of trees between 80-100 years old. Species composition includes ponderosa pine, Douglas fir, incense cedar, sugar pine, black oak and madrone. Basal area ranges from about 160 to 350 sq. ft. per acre. Average precipitation is between 40-50 inches annually (Source: Rantz, S.E. 1969. Mean Annual Precipitation in the California Region. U.S.G.S. Menlo Park, CA).

The first site we visited was a group kill of ponderosa pine. A salvage sale was conducted in the area in 1995 to capture the volume from trees that were storm damaged the previous winter (1994-1995). Based on recollections from the group, the pocket of mortality (about 50 trees) faded during the spring of 1996. Fading during the spring of 1996 indicates that the trees were attacked during the fall of 1995. The area of concentrated mortality was not harvested due to its location across a stream channel. The trees had been attacked and killed by western pine beetle (WPB), Dendroctonus brevicomis. Several of the dead trees were also attacked by red turpentine beetle (RTB), Dendroctonus

valens, a secondary invader in most cases. RTB attacks were also present on some of the residual live trees in the area. RTB pitch tubes were visible up to 15 feet on some tree boles.
No trees were found to have current WPB activity associated with them. Please see the attached information sheets on western pine beetle and red turpentine beetle biology.

Discussion

Historically, the most significant, widespread, weather-related effect on the vegetation in California has been conifer mortality associated with severe moisture stress. Conifer mortality tends to increase whenever winter precipitation is less than about 80% of normal. Trees stressed by inadequate moisture levels have their normal defense systems weakened to the point that they are highly susceptible to attack by bark, engraver and wood-boring beetles. Bark beetle-related mortality in pine typically occurs as small groups of trees, however, large group kills are not uncommon during periods of protracted drought and/or other stress inducing conditions. Successful attacks by western pine beetles result in tree mortality. Although red turpentine beetle attacks do not normally cause tree mortality, their presence is often an indicator of tree stress. It is unusual to find attacks above dbh (4.5 ft) unless the trees are severely stressed or the beetles are responding to fire-related damage, wounding or a thinning treatment.

Western pine beetles attacked the pocket of trees during the fall of 1995, prior to the occurrence of above normal precipitation recorded for that water year. Below normal precipitation was recorded nine of ten years prior to 1995. Observations from previous droughts, which were shorter in duration, indicate that tree response to increased moisture is not immediate and that a decline in mortality levels may not be apparent for 1-2 years following a normal precipitation period. These trees were not healthy or vigorous enough to withstand several years of drought combined with western pine beetle attacks. Typically, during drought periods mortality levels are higher in overstocked stands. The current basal area of many of the stands in the Shields Camp area is above what the site can support. This, coupled with protracted drought periods, often culminates in unacceptable levels of mortality.

Concern was expressed by several in the group about the possibility that the WPB group kill resulted from not removing all of the storm damaged trees. This is highly unlikely as WPB do not typically breed in slash or storm breakage material (is. broken tops and limbs) and there is little evidence that indicates they are attracted to broken off stobs. In addition, the salvage activities that took place had no effect on the subsequent WPB activity. The western pine beetles associated with the large group kill emerged during the spring of 1996. A limited survey of the immediate surrounding area indicated that there were no trees under current attack. This pattern of mortality is commonly seen with western pine beetle. Observations of group kill dynamics in west-side Sierra Nevada stands do not suggest that western pine beetles consistently attack nearby pines upon emergence. The specific location of new group kills are unpredictable as beetles may fly for some unknown distance and direction before attacking a new host tree. Therefore, the surrounding stands have the same likelihood of being attacked as distant stands.

Effects resulting from bark beetles may include the following: direct tree mortality, openings that vary in size, less trees/acre, reduced canopy closure, increase in standing dead and down woody material, increase in fuel load, increase in decomposition and nutrient cycling, increase in species diversity/decrease in species diversity, increase in snags and cavity nesting opportunities and a change in species composition. The importance or significance of these effects depends on their severity and extent and ultimately how they affect (positively and/or negatively) ecosystem structure and function (desired condition) and specific management goals and objectives.

The second site we visited was the Shields Camp underburn. The objective was to examine any subsequent bark beetle activity in fire damaged trees and to discuss the probability of residual tree mortality associated directly with fire damage (ie. crown and/or cambium kill). The prescribe burn took place during the spring of 1996. Adjacent areas are scheduled to be burned this fall. The objective of the burn was to reduce the understory fuels (stems <5 inches in size). Jay Hastings, BLM, estimated that the prescribed burn reduce the fuels by 25%. Bark beetle activity was limited to attacks by WPB in a pocket of 5 trees within the burned area. RTB attacks were not present on the trees we examined. Although still somewhat early to tell, bark beetle-related mortality did not appear to be exacerbated by the prescribed burn.

Management Alternatives

The following may be used to develop management alternatives leading in the direction of stand restoration and maintenance.

(1) No action - The effect of this alternative on future (1-2 years) levels of western pine beetle related mortality in the Shields Camp area is minimal. As noted above, the population of bark beetles associated with the large group kill have already emerged therefore leaving or removing the trees will have no effect on subsequent mortality levels (see salvage below). Although some mortality is desired for snags, small openings and for future down woody debris, the no action alternative will most likely result in delaying the attainment of the stand components that contribute to management objectives for this area.

In general, mortality will be above background levels as stand density continues to increase above that which the site can support. Mortality levels should be expected to increase during periods of below normal precipitation, particularly in overstocked stands. The direct result of an increase in tree mortality is the increase of standing dead (snags) and down woody material. This may result in: a continuing desire to enter stands to conduct salvage operations, an increase in fuel loading; fewer large, older trees; fewer of the mid-diameter trees that represent the pool from which the large trees and snags of the future come from; and a short term increase in nutrient cycling.

(2) Salvage - Salvage sales can minimize the economic loss and reduce the amount of standing and down fuel loadings; however, these operations will have no effect in reducing or controlling bark beetle populations. At the present time, there are no biologically effective or economically efficient methods available to reduce western pine beetle populations on an area-wide basis such

that tree mortality will be reduced to acceptable levels. As a general rule, during periods of above normal tree stress, it is recommended that logging, thinning and timber stand improvement work be minimized as much as possible to reduce the potential for additional stress. Where such activities must occur, extra care should be taken to prevent damage to residual trees.

(3) Thinning Overstocked Stands - Management activities that promote tree health and vigor also reduce the susceptibility to successful bark beetle attack; however, increased tree health and vigor will not be an immediate response. Thinning is perhaps the most critical silvicultural treatment available to restore and maintain forest health. Thinning from below reduces flammable fuels, and creates growing space for trees. Silvicultural prescriptions designed to reduce basal area should result in lower levels of bark beetle-related mortality in the future. Through thinning activities, the stocking could be adjusted to a level appropriate for the site. A level of 70-80% of normal basal area would produce a residual stocking of around 194 to 221 square feet per acre. The trees designated for removal would depend upon the management goals and objectives for the area. Mortality would continue to occur and fluctuate in response to the amount of available moisture, but at levels that, through time, would more closely approximate naturally occurring mortality levels. Thinning would result in a decrease in the need to enter stands to conduct salvage operations and a decrease in the amount of fuel loading.

Snags, down woody material, and nutrient cycling would occur at more natural levels. The improved growing conditions should result in reduced mortality of large diameter trees and an increase in mid-diameter trees available to grow into large diameter classes. Selecting for diversity of tree species during thinning and planting is desired as bark beetles are fairly host-specific and diversity should guarantee that some trees will remain alive during elevated stress periods. Dependent upon slash treatment, there may be some level of risk of subsequent pine engraver-related top-kill and/or whole tree mortality to residual pine trees, particularly during drought years.

(4) Prescribed fire - Prescribed burning is recognized as a viable alternative to achieve natural fuels reduction and other management objectives and is generally considered an integral part of ecosystem management and the maintenance of forest health. The following discussion focuses on entomological consideration that may be useful in planning, implementing, and monitoring prescribed burns.

Conifer survival after fire depends on (1) the condition and vigor of the trees at the time of the fire, (2) the type and severity of the fire injuries sustained, and (3), the environmental conditions that occur after the fire, including weather, and insect and disease population dynamics. Fire injuries often associated with conifer mortality include amount of crown kill, the extent of cambium or root injury, and the combination of the two. It has been well documented that insects, mainly bark beetles (Scolytidae) and various secondary bark beetles and wood boring insects (including Cerambycidae, Buprestidae, and Siricidae) attack fire injured trees. However, more detailed information is needed on the relationship(s) between the host tree, the insects and the fire injury. From an entomological perspective, a better understanding is needed of fire injury with respect to (1) subsequent insect-related tree mortality and (2) the extent to which fire-damaged trees

contribute to the build-up of insect populations and, (3) the consequent mortality to nearby unburned trees.

It should be recognized in planning prescribed burns that there is some level of risk that a particular burn will result in subsequent insect-related mortality. This level of risk is related to the probability that the fire will burn out of prescription and cause crown kill and injury to the cambium and/or roots, predisposing the trees to bark beetle attack. Typically, ponderosa pine can survive cambial injury up to 25% of the bole circumference and crown kill up to 90% if the tree growth was good prior to the fire. The impact that such mortality would have on management goals and objectives also needs to be assessed. These two considerations, the risk of fire/bark beetle-related mortality and the subsequent resource impacts, are of primary concern from a pest management standpoint. Both should be taken into account from an interdisciplinary perspective by resource managers when deciding whether or not to burn a particular stand or area and when prioritizing areas to be considered for future prescribed burning. Additional considerations include past experience (i.e. the actual effects of previous prescribed burns in similar stands on short- and long-term management goals and objectives compared to the pre-burn expected effects), what level of fire/bark beetle-related mortality would be acceptable and the experience of the personnel available to plan and conduct the burn.

There is an apparent need to obtain and evaluate information on the effects of prescribed burns on clearly stated management goals and objectives. An appropriate level of monitoring should be specifically included in burn plans, not just in terms of immediate burn implementation, but also relative to diverse resource impacts and the desired future condition of the stand after burning.

Conclusion

Implementation of alternatives 2 and 3, combined with vegetation restoration activities in the area killed by western pine beetle will most likely result in obtaining and maintaining the management goals and objectives for this area. The reintroduction of fire will improve the long-term health of these ecosystems. Competition from understory vegetation will be reduced thus increasing the growth and vigor of the residual trees, nutrient cycling will increase and the probability of a stand replacing wildfire will decrease. Objectives to be considered when selecting alternatives should include restoring the resistance and resilience to natural stresses, decreasing the risk of catastrophic fires, and modifying the vegetation to reduce potential damages caused by insects and diseases.

If you have any questions regarding this evaluation or need additional assistance please call me at 916-257-2151 ext. 6667.

Sheri Lee Smith
Entomologist
NE CA Shared Service Area

Western pine beetle

The western pine beetle, Dendroctonus brevicomis, has been intensively studied and has proven to be an important factor in the ecology and management of ponderosa pine throughout the range of this host species. This insect breeds in the main bole of living ponderosa pine larger than about 4 inches dbh. Normally it breeds in trees weakened by drought, overstocking, root disease, dwarf mistletoe or fire. Adult beetles emerge and attack trees continuously from spring through fall. Depending on the latitude and elevation, there can be from one to four generations per year.

Evidence of Attack

Initial attacks are made about mid-bole and subsequent attacks fill in above and below. Pitch tubes, formed on the tree trunk around the entry holes are made by the attacking females. The pitch tubes are red-brown masses of resin and boring dust. Relatively few, widely scattered, white pitch tubes usually indicate that the attacks were not successful and that the tree will survive. Pheromones released during a successful attack attract other western pine beetles. Attacking beetles may spill over onto nearby apparently healthy trees and overwhelm them by sheer numbers.

Life Stages and Development

These beetles pass through the egg, larval, pupal and adult stages during a life-cycle that varies in length dependent primarily upon temperature. Adults bore a sinuous gallery pattern in the cambium and the female lays eggs in niches along the sides. The larvae are small white grubs that first feed in the phloem and then mine into the middle bark where they complete most of their development. Bluestain fungi introduced during successful attacks probably contribute to the rapid tree mortality associated with bark beetle attacks.

Conditions Affecting Outbreaks

Outbreaks of western pine beetle have been observed, and surveys made, in pine regions of the West since 1899. An insect survey completed in 1917 in northern California indicated that over 25 million board feet of pine timber had been killed by bark beetles. Information from surveys initiated in the 1930s indicates that there were enormous losses attributed to western pine beetle around that time. During this outbreak, most of the mortality occurred in stands of mature or overmature trees of poor vigor.

Under normal conditions the western pine beetle breeds in a few overmature trees, unhealthy trees, or in trees weakened by drought, stand conditions, or fire. The availability of suitable host material is a key condition influencing western pine beetle outbreaks. In northeastern California, drought stress may be the key condition influencing outbreaks in that healthy trees undergo sudden and severe moisture stress and become suitable host material for attacking beetles. Healthy trees ordinarily produce abundant amounts of resin, which pitch out or eject attacking beetles. But, when deprived of moisture, stressed trees cannot produce sufficient resin flow to resist attack. Any condition that results in excessive demand for moisture, such as tree crowding, competing vegetation or protracted drought periods; or